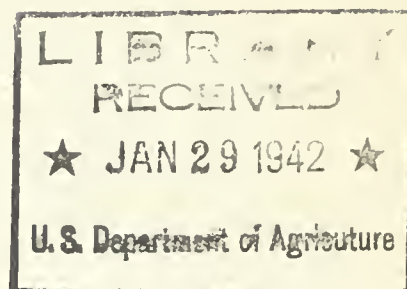


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THE FIELD STATUS OF PARASITES OF THE EUROPEAN CORN BORER
AT THE CLOSE OF THE 1940 SEASON

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In the fall of 1940, immediately subsequent to the establishment of seasonal equilibrium in the relationship between host and parasite, surveys were conducted to obtain information on the current status of parasites of the European corn borer. No attempt was made to randomize the location of sampling points over the entire area infested by the corn borer, because continuous observations throughout the years following the colonization of parasites have been such as to provide adequately reliable information on their dispersion characteristics. Commensurate with funds available, the areas surveyed were selected, therefore, with a view to obtaining the maximum information pertaining to (1) the fluctuations of parasite abundance at representative colony sites where dispersion restrictions had been determined previously, (2) abundance status, coupled with directional dispersion tendency and the extent of dispersion in areas where the parasites were still in the process of dissemination, (3) a qualitative and quantitative analysis of the parasite complex in both types of areas, (4) establishment of parasites at sample dispersion colony sites. With the data thus obtained for the current season, supplemented by the results of investigations in previous years, data are available to permit a close interpretation of the status of parasites throughout the entire infested area.

Collections of ectophagous parasites and the puparial remains of those which issued from their host and emerged prior to the time of collection, together with living borers which might harbor endophagous forms, were made at 16 points. The size and number of collections taken at each locality and the design utilized to locate the sampling point were determined by the type of information desired and the status of the introduced parasites prior to 1940 in the area to be surveyed. Host and parasite material from the Lake States (including the western portions of New York and Pennsylvania) and the Eastern States area were handled at the corn borer laboratories at Toledo, Ohio, and Moorestown, N. J., respectively. The results of observations in both areas are summarized in tables 1 and 2.

Table 1.--Corn borer parasitization in certain localities in the Lake States area at the close of 1940

State and locality	County	Lydella: Eulo- : grises- : cens	Inar- : eolata : punc-	Macro- : centrus : gif-	Aplomya: caesar:	Undeter- mined	Total
		Number	Percent	Percent	Percent	Percent	Percent
Michigan:							
Erie Township	Monroe	286	19.9	0	0	1.4	2.1
New York:							
Cattaraugus Indian Reserv.		420	0	0	0	0	0
Ohio:							
Adams Township	Lucas	510	2.5	0.2	0.4	0	0.2
Berlin Township	Erie	220	7.3	0	0	1.4	0.4
Jerusalem Township	Lucas	615	11.7	0.3	0	0.2	1.3
Perkins Township	Erie	309	48.5	0.3	0	0.3	1.3
Total		2,360	--	--	--	--	--

Table 2.--Corn borer parasitization in certain localities in the Eastern States at the close of 1940

State and locality	County	Area	Borers observed	Parasites recovered				Chelonus annulipes	Total
				Lydella griseus	Inareolata punctoria	Macrocentrus gifuensis	Percent	Percent	Percent
		Sq. mi.	Number	Percent	Percent	Percent	Percent	Percent	Percent
Connecticut:									
E. Hartford	Hartford	415	6,426	2.5	12.9	0	0.1	15.5	
Haddam	Middlesex	7	479	7.9	4.0	0	0	11.9	
Massachusetts:									
Agawam	Hampden	7	454	2.0	21.4	0	0	23.4	
Barnardston	Franklin	7	196	2.6	0	0.5	0	3.1	
Hadley	Hampshire	7	460	19.6	8.9	0	0	28.5	
Northeastern	--	36	1,388	0.5	14.9	0.3	0	15.7	
Southeastern	--	1,964	4,345	9.6	2.8	17.1	0.8	30.3	
New Jersey:									
Atlantic	Monmouth	20	1,962	3.5	2.2	0.7	0	6.4	
Burlington	Burlington	31	2,899	3.2	0	0	0	3.2	
Virginia:									
Lee	Accomac	24	979	4.1	0	(1)	0	4.1	
Total	--	2,518	19,588	--	--	--	--	--	--

1/ No release of this species at point indicated.

Status of Parasites

Lydella stabulans var. grisescens R.D. -- This tachinid is the most widely dispersed of the exotic corn borer parasites. In the Lake States it was the only parasite known to be attacking the corn borer in appreciable numbers up to the close of the 1940 season, and in this region it was present only for a limited distance inland in the vicinity of marshland bordering Lake Erie from the southern city limits of Detroit, Mich., to the Huron River west of Sandusky, Ohio. It is not known to have maintained itself near the marshland bordering any of the smaller lakes or ponds or at any other point in the Lake States area. The localities in which the parasite occurs comprise only a small part of the infested area, but at certain points as shown by the 1940 surveys and probably wherever marshland is abundant on the Lake Erie shore, high concentrations of the parasite exist. At Perkins Township, Erie County, Ohio, and at Erie Township, Monroe Co., Mich., two points selected as being representative of the Lake Erie marshland environment, a considerable increase in the percentage of parasitization by L. grisescens over that of 1939 was noted. At the former point one collection showed a parasitization of 85.1 percent, and the average for the area surveyed was 48.5 percent.

In the Eastern area L. grisescens was taken at all points surveyed and was either the most abundant or the second most abundant parasite in each case. In southeastern Massachusetts the percentage of parasitization was double that of 1939. In 11 of the collections from this locality over 25 percent of the borers had been killed by this dipterous parasite. In the Connecticut River Valley in Massachusetts, where Lydella grisescens was released in 1935, the 1940 surveys show the parasite to be well established. In central Connecticut, in the vicinity of Hartford, this tachinid was slightly more prevalent west of the Connecticut River but was present in small numbers throughout the 415 square miles of the surveyed area. It was also found to be well established at Haddam, Middlesex County, Conn., where a release had been made in 1935. L. grisescens, released in Atlantic Township, Monmouth County, N. J., in 1935, was found to be well established, increasing, and spreading. At Burlington Township, Burlington County, N. J., a recently established release point L. grisescens was the only parasite recovered. Parasitization by it was low but considerable dispersion was evident. L. grisescens was also the only parasite reared from borers taken from the Lee, Accomac County, Va., locality.

Inareolata punctoria Roman. -- This ichneumonid parasite was recovered at only one point in the Lake States, namely, in the vicinity of the Cattaraugus Creek, in the Cattaraugus Indian Reservation, N. Y. The limited survey at this point did not permit exact definition of the area in which the parasite was present. Because the parasite has been recovered in this locality whenever observations have been made, and in view of the decided increase in its abundance since the last recovery in 1935, it appears probable that I. punctoria has become a permanent part of the fauna of the locality.

At the Erie Township, Monroe County, Mich., release point, where this ichneumonid persisted for 5 years following its last release, no recovery has been made for 3 years. However, since the parasite has been noted in miscellaneous collections in the vicinity of Toledo in 1938 and 1939, it is possible

that it is present in that locality and, since it has been widely colonized in the Lake States, it is possible that it is present at other colony sites.

In the Eastern States I. punctoria is almost as widely dispersed as Lydella grisescens and in some localities it is more abundant. In northeastern Massachusetts it was the most important parasite and killed 14.9 percent of the borers collected. It was reared from 94 percent of the collections obtained in this locality. I. punctoria was reared from 36 individual collections in southeastern Massachusetts and averaged 2.8 percent parasitization of all borers observed from this locality. The percentage of parasitization and the dispersion of the parasite into new areas showed a gain in 1940 over 1939. In 1939 the maximum parasitization recorded for this species in any collection from this locality was 10.8 percent. In 1940 parasitization by I. punctoria in 7 collections was equal to or above the 1939 maximum. I. punctoria was recovered from two of the three release points examined in the Connecticut River Valley in Massachusetts. At Agawam one collection of borers showed a parasitization of 35.8 percent and the average for the area surveyed at this locality was 21.4 percent. I. punctoria was released at Agawam and Hadley in 1936 and 1 year later at Bernardston, where no recovery was made in 1940. The release at the last-named site was made somewhat later in the season and synchronization may not have been accomplished. The area in central Connecticut, centering at Hartford, in which field-status studies of parasites were made in 1939, included 133 square miles. This was increased in 1940 to 415 square miles but, notwithstanding this large extension, it was found that the parasites had dispersed beyond the limits of the survey. I. punctoria was the most important parasite present and parasitized 12.9 percent of the 6,426 hosts observed. It was reared from 69, or 80 percent, of the individual collections. Twenty-seven collections of host larvae showed 20 percent or higher parasitization by I. punctoria. In the central 95 square miles of the area covered, borer parasitization by this species at the close of 1939 was 10.2 percent. In the same area at the close of 1940 it was 19.9 percent. Parasitization continued to increase up to the fourteenth host and parasite generation. (The parasite was released at Hartford, Conn., in 1934.) Data indicated that I. punctoria was spreading and increasing most rapidly in an easterly direction from the point of release. It seemed to be retarded in its dispersion toward the southwest, possibly because of the prevailing summer winds from that direction. At Haddam, Middlesex County, Conn., I. punctoria was found to be well established following a release of the species at this point in 1935. At Atlantic, Monmouth County, N. J., where I. punctoria was released in 1936, it was found to be well established, increasing, and spreading.

Macrocentrus gifuensis Ashm. -- A colony of this species was released at Adams Township, Lucas County, Ohio, in 1940, to test its reaction in an environment where the multiple-generation strain of the borer had become more prevalent than it was when the parasite was originally tested in this area. Initial establishment was shown by the recovery of two colonies of the species in the immediate vicinity of the release point. Initial establishment was also noted at two (Bernardston, Franklin County, and Concord, Middlesex County, Mass.) of the numerous dispersion colony sites founded in 1940 in the eastern area. In southeastern Massachusetts M. gifuensis was the most important parasite. It killed 17.1 percent of the 4,345 host larvae observed in the fall of 1940 as compared with 10.6 percent of the hosts observed in the fall of 1939. Borers

in 16 individual collections averaged 40 percent or higher parasitization by this species and the maximum parasitization of 71.1 was observed. It was reared from 83 of the 99 individual collections made and is known to be present over an area of approximately 1,700 square miles in southeastern Massachusetts. It was recovered east of the Canal on Cape Cod as far out as the town of Mashpee. Its spread westward has been comparatively slow. M. gifuensis, released in 1939 and 1940 at Atlantic, Monmouth County, N. Y., was well established at this point, and considerable dispersion was indicated by its recovery 2 miles from the point of release.

Eulophus viridulus Thoms. -- This gregarious ectophagous chalcid parasite was first released in the Lake States area in 1931 but no recovery was made until 1938. Since then surveys have shown that, although the parasite has spread, it has not notably increased in abundance at any point. During the 1939 season it had been found that E. viridulus had dispersed a considerable distance in the counties south of Toledo, Ohio. In order to check further on this spread observations were made in six counties not examined in 1939. These counties were Allen, Auglaize, Hardin, Logan, Seneca, and Sandusky. Only one observation per township was made and only a few townships in some of the counties were included in the survey. The parasite, however, was recovered in all counties under observation and it was indicated that at some points the species may be present in encouraging numbers. One colony was found over 50 miles from the nearest release point. The farthest limits of dispersion were not defined by this survey and, because of the limited observations, no dispersion direction tendency can be drawn from the data. No recovery of this species was made in the eastern area.

Chelonus annulipes Wesm. -- This braconid, released in 1938 in the multiple-generation area west of Toledo, Ohio, although showing strong establishment for 2 years, failed to appear in the 1940 collections from the Lake States area. In southeastern Massachusetts C. annulipes was not more abundant in 1940 than it was in 1937 and 1938 and less numerous than it was in 1939. The area from which it was taken remains rather limited. Parasitization of the borer by this braconid was only 0.8 percent and it was reared from only 7 of the 99 host collections from this locality; however, parasitization was over 10 percent in 4 of the 7 collections from which the parasite was reared. Since the parasite was present in rather large numbers in the fields from which it was taken and since these fields were more or less scattered and no individuals were reared from borer collections from intervening fields, it is indicated that C. annulipes is very selective in its choice of environment. This characteristic is further emphasized by the recovery of Chelonus at only 1 point in the Hartford, Conn., area, where a number of closely spaced releases had been made in 1939 and where the parasite had been recovered in 5 collections taken in the fall of that year.

Native parasites. -- The following native parasites appeared in small numbers in the 1940 collections: Aplomya caesar Ald. from the Lake States collections; and Carcelia ochracea V.d.W., Macrocentrus robustus Mues., Bassus agilis Cress., and Labrorychus prismaticus Nort. from the Eastern States.

Resume of Status of Parasites of European Corn Borer

at Close of 1940 Season

Lake States area. -- This area includes only the western portion of New York and Pennsylvania. The 1940 fall survey indicates that in the Lake States area Lydella grisescens was the only parasite present in concentrations sufficiently high to be of economic importance and this status exists only in a narrow area bordering the marshland on the southwestern shore of Lake Erie. The species is not known to have maintained itself near the marshland bordering any of the smaller lakes or ponds or at any other point in the Lake States area.

Eulophus viridulus is present over a considerable part of the infested area in northwestern Ohio. The exact limits of its dispersion have not been determined but at no locality has it been found to be abundant.

Inareolata punctoria is present over a limited area in the vicinity of the Cattaraugus Creek, in the Cattaraugus Indian Reservation, N. Y. It was not recovered at any other point in the area in 1940, and, although, it possibly is present in extremely low concentrations at one or more points in the area (since it has been widely colonized), it is probably of no economic importance at any other locality in the Lake States.

Macrocentrus gifuensis was recovered at only one point in the area and there only as a result of a current season's release.

At present no exotic parasite other than those cited above is on a maintenance basis in the Lake States area nor does it seem probable that any other of the parasites imported to date will prove of value in the area where the one-generation strain of the borer is strongly predominant. It is known that over the greater part of the infested area in the Lake States no parasite, either native or of foreign origin, is present in numbers sufficient to be of any economic value.

Eastern States area. -- In the Eastern States, however, including eastern New York and Pennsylvania, where the multiple-generation strain of the borer predominates, the picture of corn borer parasitization presents a different aspect. The surveys of 1940, together with those of recent previous years, show that the two parasites, Lydella stabulans var. grisescens and Inareolata punctoria, are present over a considerable part of the infested area. Of the many widespread dispersion colony points of these two species, good establishment was found at practically all of those which it was possible to examine in 1940. From sampling the dispersion points and from observations at the earlier established test points, it is known that these two species are present in considerable concentrations throughout eastern Massachusetts and Rhode Island, throughout the Connecticut River Valley from the Massachusetts-New Hampshire line to Long Island Sound, in Suffolk County on Long Island, and at one or more points in New Jersey. L. grisescens is present on the Eastern Shore of Virginia.

That Macrocentrus gifuensis shows promise of becoming one of the most valuable parasites in the multiple-generation area is shown by its performance in southeastern Massachusetts and, as demonstrated by the 1940 surveys, by its ability to become established under the varied environments of dispersion colonization.

Chelonus annulipes has not been found in abundance at any point, probably because of its apparent highly critical environmental requirements but, in view of its continued maintenance over a long period in southeastern Massachusetts, it seems probable that by close colonization, conditions favorable for its increase may be found in restricted ecological islands in the multiple-generation area.

Cremastus flavoorbitalis was taken at one point in Rhode Island in 1940, but observations do not offer promise of this parasite becoming of economic value in the regions where it has been colonized to date.

Observations in previous years have shown that Phaeogenes nigridens Wesm. is present in eastern Massachusetts. No surveys were made to check its current status, but, in view of the slow increase and spread shown by previous surveys, it is probably not of economic importance at any point.

Data available up to the close of the 1940 active season show that throughout the Lake States no parasites of the European corn borer are of economic importance except in a narrow strip bordering marshland along the southwestern shore of Lake Erie where Lydella stabulans var. grisea is present in high concentrations. In the Eastern States three parasites, L. stabulans var. grisea, Mareolata punctoria, and Macrocentrus gifuensis, are present in considerable abundance over the greater part of the more heavily infested areas and satisfactory establishment at sampled dispersion colony sites indicate that these three parasites are present throughout a considerable part of the entire infested area of that region.